

Reply to the comments of Reviewer #2

This manuscript analyses aerosol particle sources over the Arctic Ocean during summertime based on in situ measurements conducted during several cruises. The analysis appears to be scientifically sound with no major errors. The paper is well structured and clearly written. Thank you for the encouraging review.

I have a few suggestions for improving the paper a bit further.

The last two paragraphs of "Introduction" mainly list the contents of the paper. Preferably, scientific goals of this paper should be listed as well. What is the main goal of the paper? Which questions the paper is searching for answers?

At the end of the revised and shortened introduction we added “With the combined data set and the clustering algorithm the main goal of the present study is to identify potential source regions of aerosol particles observed over the central summer Arctic. Specifically, we would like to differentiate between local sources within the pack ice region and distant sources. Extending our previous analyses discussed above with the locally measured parameters to different source regions we aim at identifying factors controlling the aerosol life cycle over the inner Arctic.”

The authors test their clustering algorithm in section 4. Rather than just saying “lending confidence in” at the end, I would recommend adding a short (2-3 sentences) summary of the outcome of this testing exercise. Now the reader needs to make his/her own judgment of whether and how well the chosen approach performs.

Instead of the last sentence of section 4 we now state: “The test of the clustering algorithm with all available DMS(g) data has the following outcome: The potential source regions identified by the algorithm in the MIZ and adjacent open waters agree with previous DMS studies. Consequently, we expect the clustering algorithm to be able to identify other potential source regions of the surface aerosol over the Arctic summer pack ice.”

The last section of the paper (synopsis and conclusions) would benefit of having a paragraph discussing the major implications that the findings made here might have in terms of the Arctic climate system. One line related to this issue could also be added to the “Abstract”.

We gladly take up this suggestion and formulated: “What are the possible implications of our findings for the Arctic climate system? In the course of the ongoing reduction of the summer pack ice favorable biological conditions for new particle formation might increase over the Central Arctic with more frequent broken-ice or open water patches. More open water increases biological activity in surface water promoting the formation of biological particles. Consequently, number concentrations of small particles might increase over the inner Arctic. Provided that enough condensates are available, e.g., DMS oxidation products or emissions from increasing Arctic shipping, more cloud condensation nuclei might result, which would affect the prevalent low clouds and fogs in the summer Arctic. Changing clouds would affect the surface energy balance, which in turn would have effects on ice melt.”

We added to the Abstract: “Future more frequent broken-ice or open water patches in summer will spur biological activity in surface water promoting the formation of biological particles. Thereby low clouds and fogs and subsequently the surface energy balance and ice melt may be affected.”

Minor/technical issues:

Page 8449, line 21: should maybe be “derived”.

Yes, thanks, changed.

Page 8454, lines 8-9: “one” and “two” are bit strange choices of words here. Maybe something like “The first case” and “The second case”.

Yes, thanks. We changed the sentence to “The first case covers polluted North Atlantic air that had passed over Svalbard (cf. Fig. 7b). The second case covers free tropospheric air that had crossed Greenland before arriving at *Oden* (cf. Fig. 7c).”

Page 8455, line 1: “super-micrometer particles”, particles missing?

Yes, thanks, “particles” added.